Appendix B

Geotechnical Soil Testing Results

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December 14, 2015

Anna Lundin
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1670 Broadway, Suite 3400
Denver, CO 80202

215333B
Anna.Lundin@HDRinc.com

Subject: Laboratory Tests Results – Xcel Coal Combustion Residuals Rule Compliance Project, Comanche Power Station.

Dear Ms. Lundin:

This letter presents the results of laboratory tests performed on samples submitted for the subject project. The test results are presented on the attached Figures 1-3 and Table 1.

If there are any questions, please feel free to contact us.

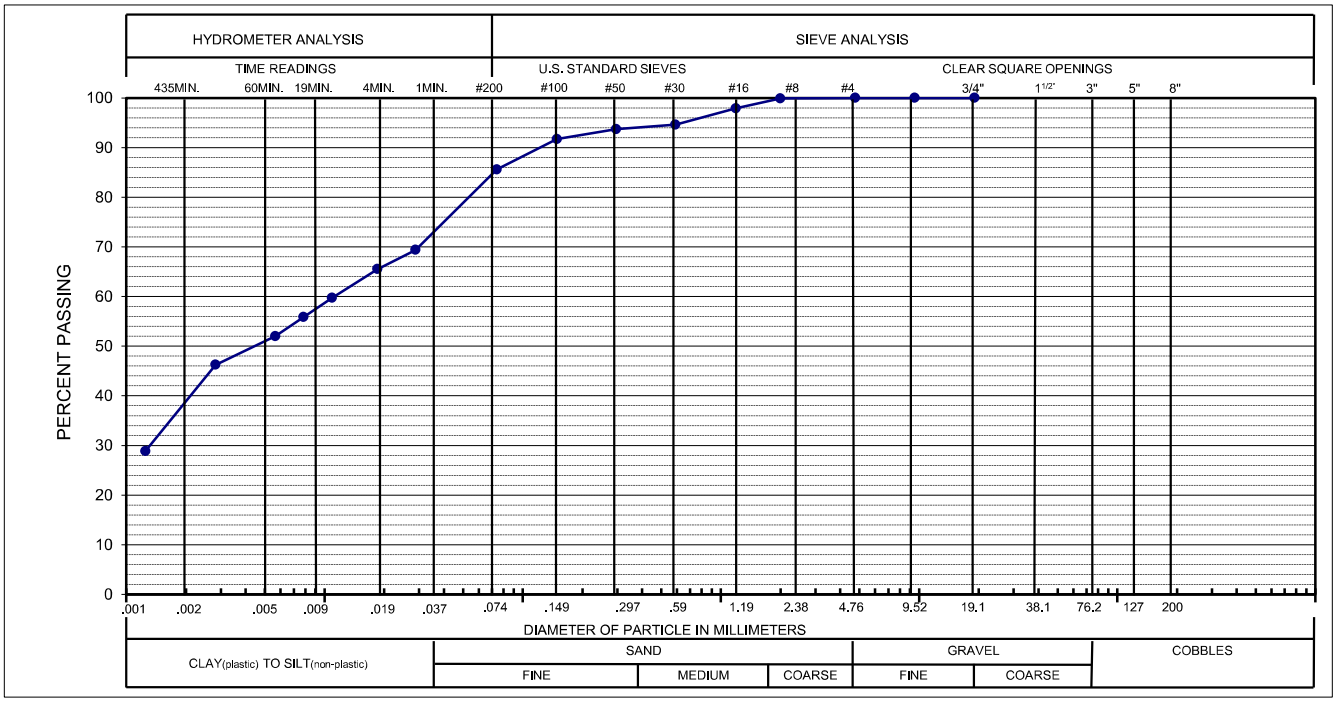
Sincerely,

HEPWORTH-PAWLAK GEOTECHNICAL, Inc.

Cuong Vu, Ph.D., P.E.

Reviewed by: Arben Kalaveshi, P.E.

215333B (Comanche) xmittal.doc



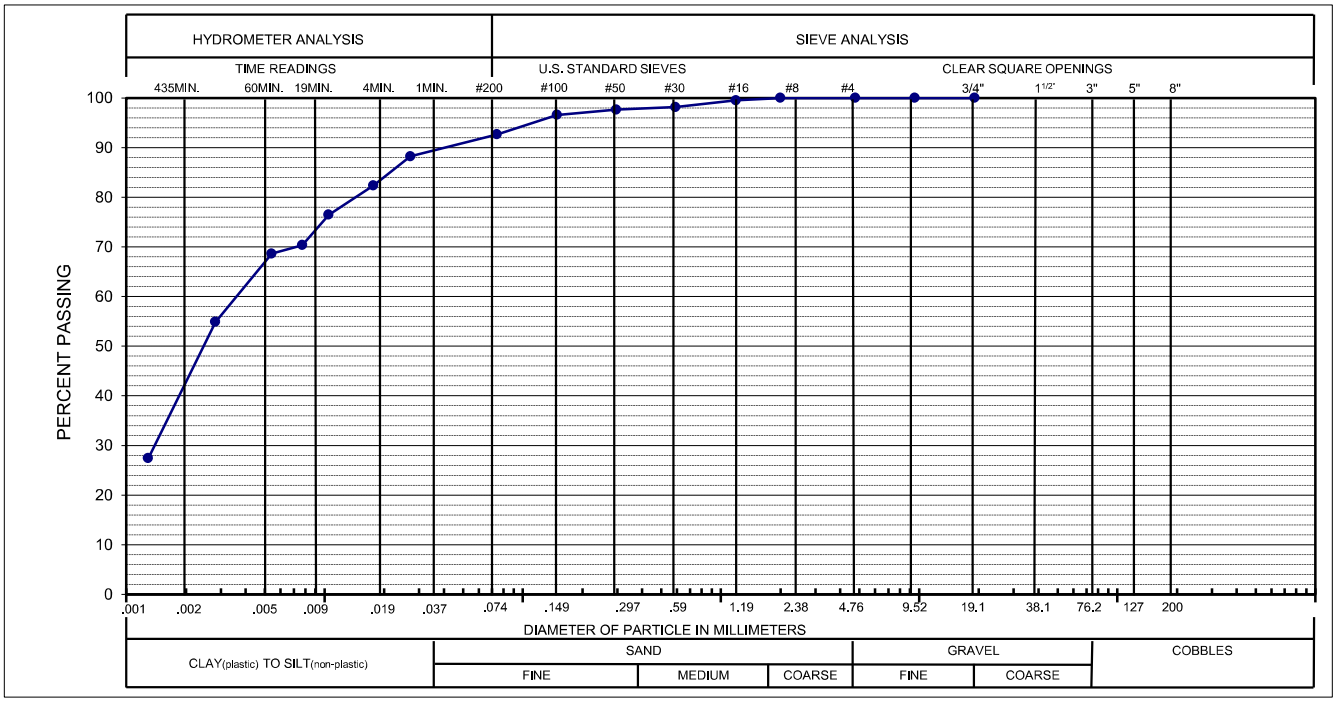
GRAVEL: 0% SAND: 14% SILT / CLAY: 86%

BORING : MW4 Specific Gravity: 2.87

DEPTH : 9 feet Porosity : 36.2%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	98
(#30)	95
(#50)	94
(#100)	92
(#200)	86
0.0288	69
0.0185	66
0.0109	60
0.0078	56
0.0057	52
0.0028	46
0.0012	29

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 1



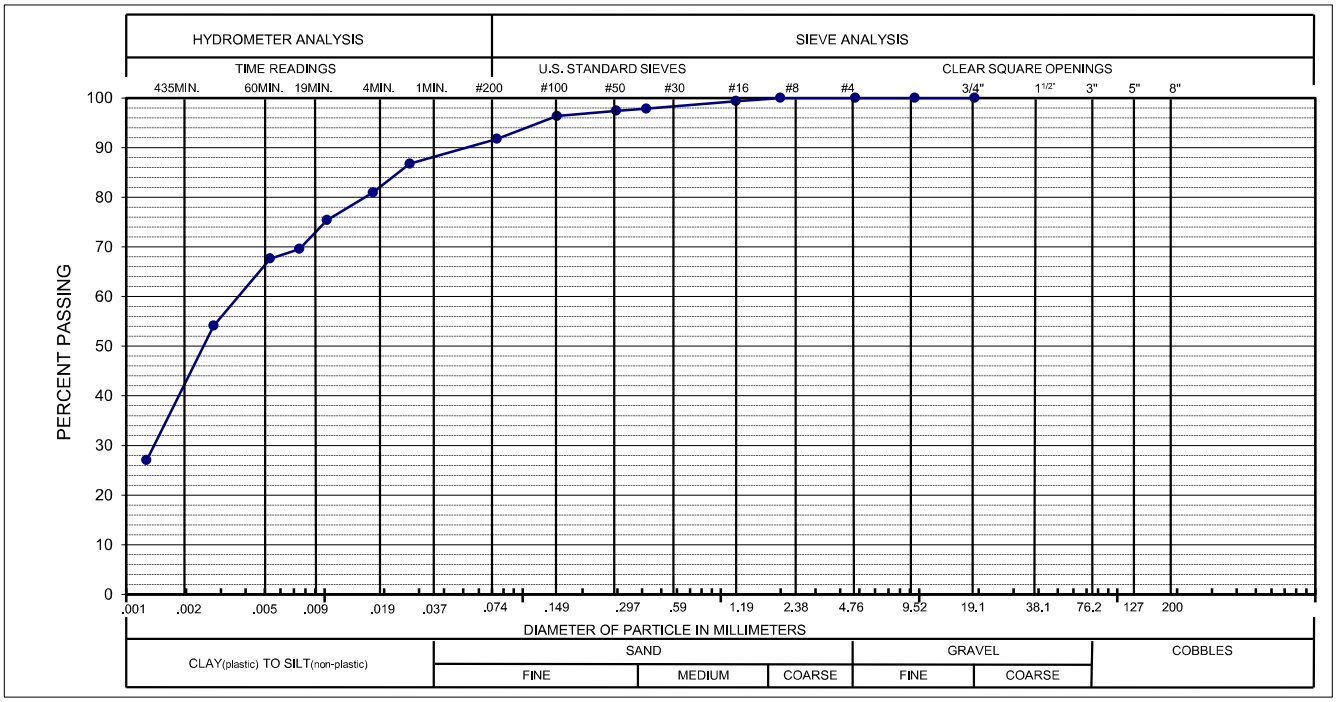
GRAVEL: 0% SAND: 7% SILT / CLAY: 93%

BORING : MW5 Specific Gravity: 2.78

DEPTH : 9 feet Porosity : 39.2%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	100
(#30)	98
(#50)	98
(#100)	97
(#200)	93
0.027	88
0.018	82
0.010	76
0.008	70
0.005	69
0.003	55
0.001	27

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 2



GRAVEL: 0% SAND: 8% SILT / CLAY: 92%

BORING : MW6 Specific Gravity: 2.85

DEPTH : 9 feet Porosity : 35.4%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	99
(#30)	98
(#50)	97
(#100)	96
(#200)	92
0.027	87
0.018	81
0.010	75
0.007	70
0.005	68
0.003	54
0.001	27

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 3

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

JOB NO. 215333B

PROJECT: COMANCHE

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY UNIT WEIGHT (PCF)	GRADATION			SPECIFIC GRAVITY	POROSITY (%)
BORING	DEPTH (feet)			GRAVEL (%)	SAND (%)	SILT & CLAY (%)		
MW4	9	17.2	114	0	14	86	2.87	36.2
MW5	9	18.9	109	0	7	93	2.78	39.2
MW6	9	17.4	115	0	8	92	2.85	35.4

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/31/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	SOIL
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	266.7	Initial Wet Density (pcf):	140.3
After Test Mass of Wet Soil (g):	266.6	Initial Dry Density (pcf):	126.9
Mass of Dry Soil and Pan (g):	247.9	Initial Wet Density (kg/m³):	2247
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2032
Diameter (in):	1.87	Initial Moisture (%):	10.6
Initial Sample Height (in):	2.64	Final Wet Density (pcf):	143.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	130.3
		Final Wet Density (kg/m³):	2306
Back Pressure (psi):	38.0	Final Dry Density (kg/m³):	2087
Cell Pressure (psi):	61.0	Final Moisture (%):	10.5

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	1.746	122.93	18.52	22.13	152.6	21.5	0.965	3.34E-09
5	--	1.12E-06	2.030	142.93	21.53	21.99	151.6	21.5	0.965	2.88E-09
5	--	1.12E-06	2.310	162.64	24.50	21.85	150.6	21.5	0.965	2.53E-09
5	--	1.12E-06	2.530	178.13	26.83	21.74	149.9	21.5	0.965	2.31E-09
5	--	1.12E-06	2.710	190.81	28.74	21.65	149.2	21.5	0.965	2.15E-09
5	--	1.12E-06	2.830	199.26	30.01	21.59	148.8	21.5	0.965	2.06E-09
5	--	1.12E-06	2.940	207.00	31.18	21.53	148.4	21.6	0.962	1.98E-09
5	--	1.12E-06	3.010	211.93	31.92	21.50	148.2	21.6	0.962	1.94E-09
5	--	1.12E-06	3.090	217.56	32.77	21.46	147.9	21.6	0.962	1.89E-09
5	--	1.12E-06	3.100	218.27	32.87	21.45	147.9	21.6	0.962	1.88E-09
5	--	1.12E-06	3.080	216.86	32.66	21.46	148.0	21.6	0.962	1.89E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.90E-09

NOTES:

Data entry by:	CAL	Date:	09/08/20
Checked by:	DPM	Date:	09/14/20
File name:	3102001__Permeability Method D ASTM D5084_0.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

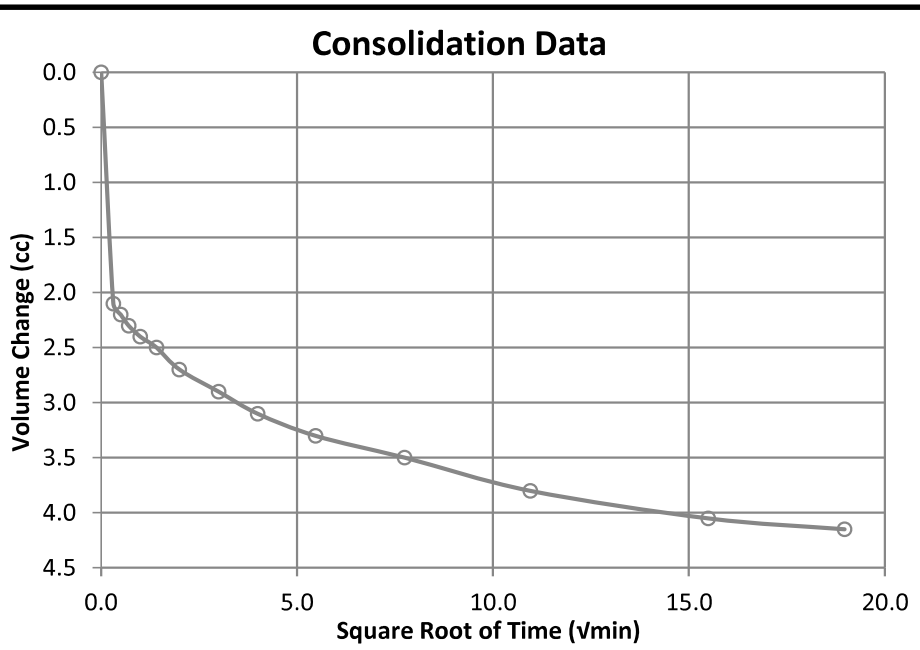
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/31/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	SOIL
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	92.0	Initial Volume of Sample (cc):	118.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	115.6
Cell Pressure (psi):	61.0	Volume Change After Consolidation (cc):	13.8
Back Pressure (psi):	38.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	23.0	Final Dial Reading (in):	0.221
Effective Stress (kPa):	158.6	Height Change (in):	0.021
Cell Expansion Correction (cc):	10.72	Initial Area (cm²):	17.74
Cell ID:	19S	Final Area (cm²):	17.42

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.90	0.00
0.1	0.32	3.00	2.10
0.25	0.50	3.10	2.20
0.5	0.71	3.20	2.30
1	1.00	3.30	2.40
2	1.41	3.40	2.50
4	2.00	3.60	2.70
9	3.00	3.80	2.90
16	4.00	4.00	3.10
30	5.48	4.20	3.30
60	7.75	4.40	3.50
120	10.95	4.70	3.80
240	15.49	4.95	4.05
360	18.97	5.05	4.15



Saturation

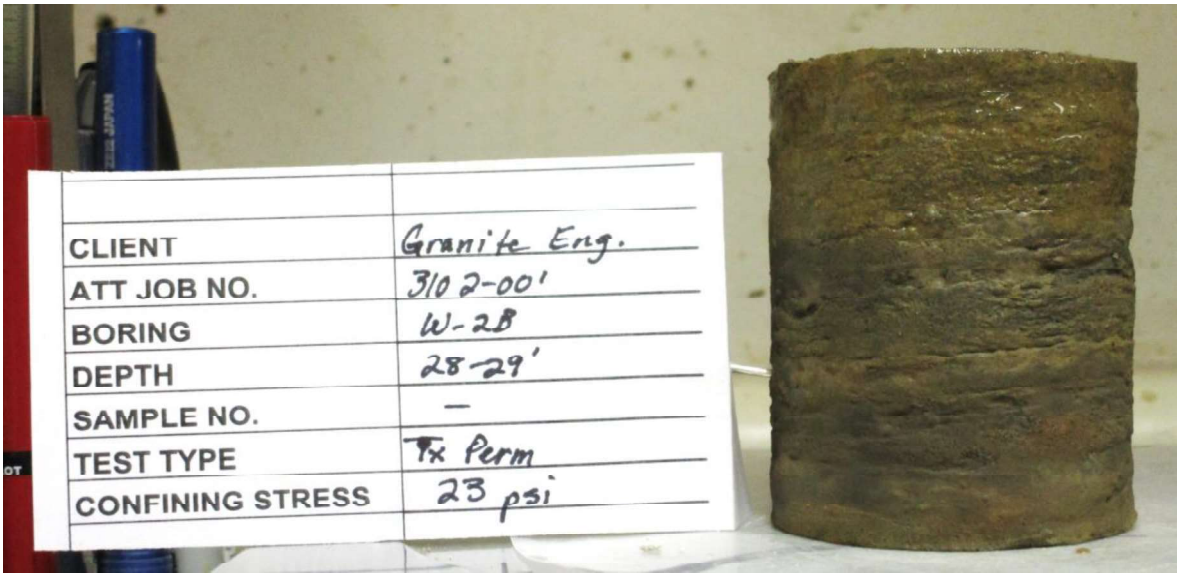
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.0	48.6	11.20	11.30	38.0	0.10	2.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_0.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/31/20
LOCATION	--	DESCRIPTION	soil



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ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/01/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	283.3	Initial Wet Density (pcf):	123.7
After Test Mass of Wet Soil (g):	309.3	Initial Dry Density (pcf):	120.0
Mass of Dry Soil and Pan (g):	538.2	Initial Wet Density (kg/m³):	1982
Mass of Pan (g):	263.4	Initial Dry Density (kg/m³):	1922
Diameter (in):	1.93	Initial Moisture (%):	3.1
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	137.7
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	122.4
		Final Wet Density (kg/m³):	2206
Back Pressure (psi):	68.0	Final Dry Density (kg/m³):	1960
Cell Pressure (psi):	83.0	Final Moisture (%):	12.6

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	5.33E-02	0.058	4.08	0.54	14.97	103.2	21.0	0.976	5.15E-03
--	--	5.33E-02	0.059	4.15	0.55	14.97	103.2	21.0	0.976	5.06E-03
--	--	5.33E-02	0.058	4.08	0.54	14.97	103.2	21.0	0.976	5.15E-03
--	--	5.33E-02	0.059	4.15	0.55	14.97	103.2	21.0	0.976	5.06E-03

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.10E-03

NOTES:

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Checked by:	DPM	Date:	09/14/20
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ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

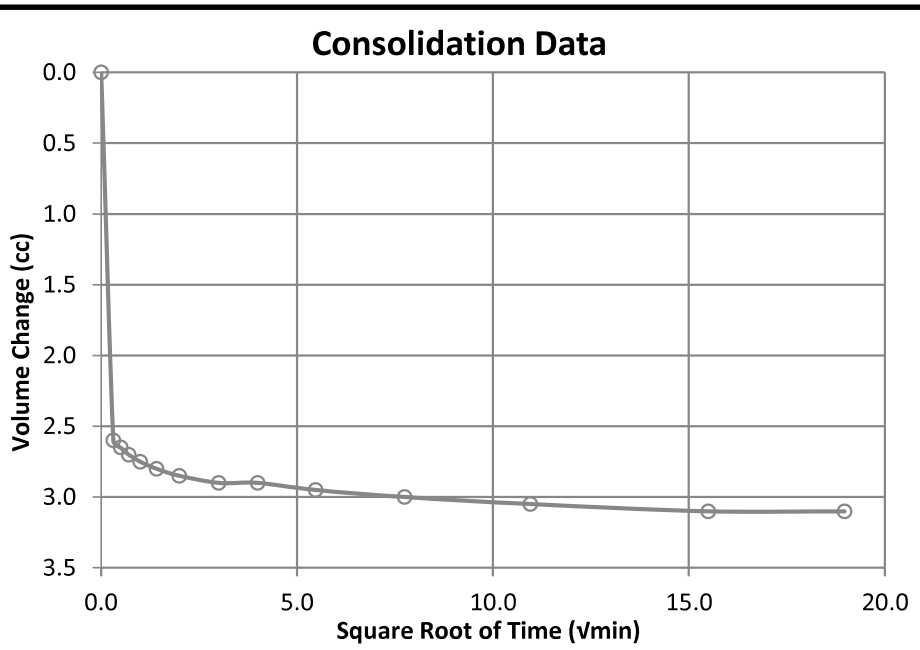
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/01/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	21.8	Initial Volume of Sample (cc):	143.0
Final Saturation (%):	94.5	Final Volume of Sample (cc):	140.2
Cell Pressure (psi):	83.0	Volume Change After Consolidation (cc):	17.65
Back Pressure (psi):	68.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	15.0	Final Dial Reading (in):	0.214
Effective Stress (kPa):	103.4	Height Change (in):	0.014
Cell Expansion Correction (cc):	14.89	Initial Area (cm²):	18.91
Cell ID:	6P	Final Area (cm²):	18.64

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	17.20	0.00
0.1	0.32	19.80	2.60
0.25	0.50	19.85	2.65
0.5	0.71	19.90	2.70
1	1.00	19.95	2.75
2	1.41	20.00	2.80
4	2.00	20.05	2.85
9	3.00	20.10	2.90
16	4.00	20.10	2.90
30	5.48	20.15	2.95
60	7.75	20.20	3.00
120	10.95	20.25	3.05
240	15.49	20.30	3.10
360	18.97	20.30	3.10



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.2	47.3	12.30	13.40	38.0	1.10	2.0	8.1	0.81
50.0	60.0	49.2	58.2	14.40	15.20	48.0	0.80	2.0	9.0	0.90
60.0	70.0	59.1	68.5	15.90	16.70	58.0	0.80	2.0	9.4	0.94
70.0	80.0	69.3	79.0	17.30	17.20	68.0	-0.10	2.0	9.7	0.97

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Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	
LOCATION	--	DESCRIPTION	SOIL

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ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6'-7'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	276.8	Initial Wet Density (pcf):	118.6
After Test Mass of Wet Soil (g):	297.4	Initial Dry Density (pcf):	102.5
Mass of Dry Soil and Pan (g):	505.1	Initial Wet Density (kg/m³):	1900
Mass of Pan (g):	266.1	Initial Dry Density (kg/m³):	1641
Diameter (in):	1.93	Initial Moisture (%):	15.8
Initial Sample Height (in):	3.05	Final Wet Density (pcf):	135.1
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	108.6
		Final Wet Density (kg/m³):	2164
Back Pressure (psi):	68.0	Final Dry Density (kg/m³):	1739
Cell Pressure (psi):	74.0	Final Moisture (%):	24.4

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 2.09E-05

NOTES:

Data entry by:	CAL	Date:	09/09/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_2.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

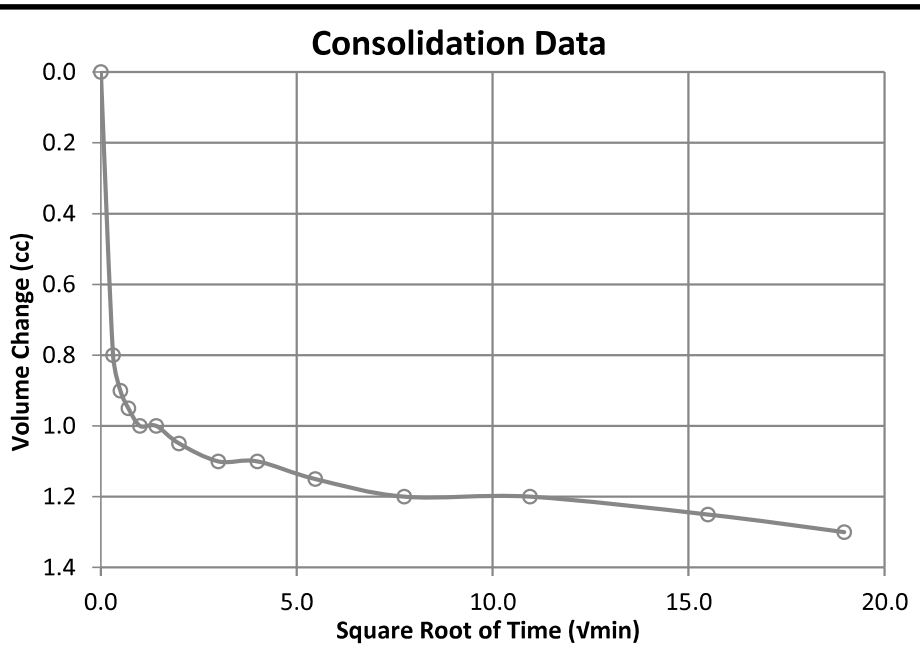
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6'-7'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	68.0	Initial Volume of Sample (cc):	145.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	137.4
Cell Pressure (psi):	74.0	Volume Change After Consolidation (cc):	18.7
Back Pressure (psi):	68.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	6.0	Final Dial Reading (in):	0.222
Effective Stress (kPa):	41.4	Height Change (in):	0.022
Cell Expansion Correction (cc):	10.49	Initial Area (cm²):	18.78
Cell ID:	5P	Final Area (cm²):	17.85

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	19.40	0.00
0.1	0.32	20.20	0.80
0.25	0.50	20.30	0.90
0.5	0.71	20.35	0.95
1	1.00	20.40	1.00
2	1.41	20.40	1.00
4	2.00	20.45	1.05
9	3.00	20.50	1.10
16	4.00	20.50	1.10
30	5.48	20.55	1.15
60	7.75	20.60	1.20
120	10.95	20.60	1.20
240	15.49	20.65	1.25
360	18.97	20.70	1.30



Saturation

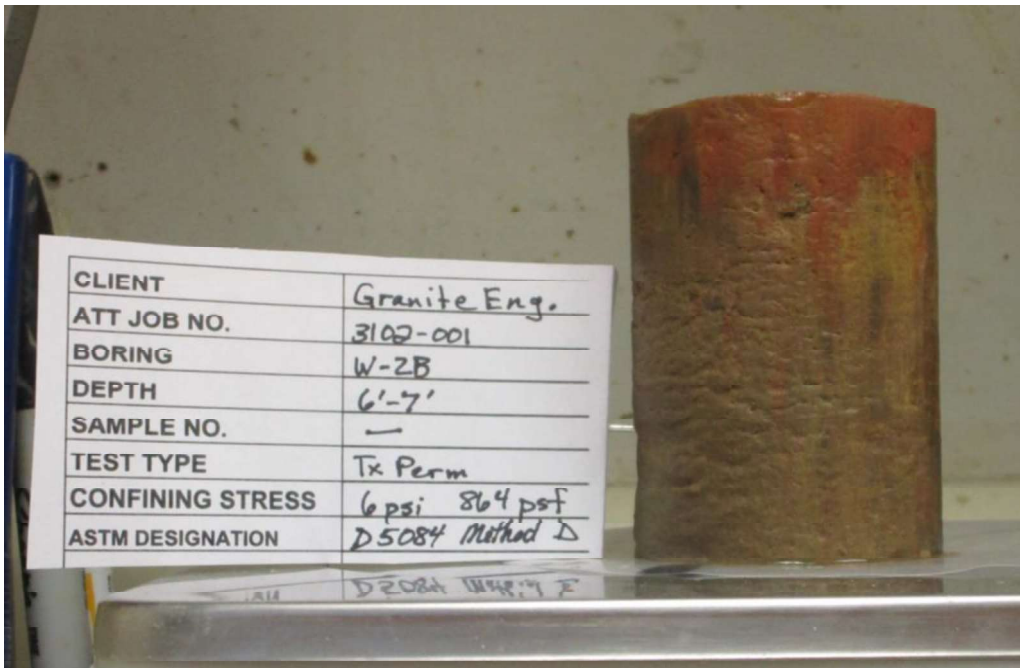
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.9	46.6	14.40	15.30	38.0	0.90	2.0	7.7	0.77
50.0	60.0	49.0	57.6	16.30	17.10	48.0	0.80	2.0	8.6	0.86
60.0	70.0	59.1	68.4	17.60	18.30	58.0	0.70	2.0	9.3	0.93
70.0	80.0	69.1	78.9	19.30	19.40	68.0	0.10	2.0	9.8	0.98

File name: 3102001__Permeability Method D ASTM D5084_2.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6-7'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/30/20
LOCATION	--	DESCRIPTION	SOIL



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ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	432.8	Initial Wet Density (pcf):	152.4
After Test Mass of Wet Soil (g):	434.2	Initial Dry Density (pcf):	145.6
Mass of Dry Soil and Pan (g):	420.0	Initial Wet Density (kg/m³):	2441
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2332
Diameter (in):	1.86	Initial Moisture (%):	4.7
Initial Sample Height (in):	4.00	Final Wet Density (pcf):	154.5
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	147.1
		Final Wet Density (kg/m³):	2476
Back Pressure (psi):	58.0	Final Dry Density (kg/m³):	2357
Cell Pressure (psi):	113.0	Final Moisture (%):	5.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	0.352	24.78	2.44	54.82	378.0	21.0	0.976	3.21E-08
--	--	1.39E-06	0.626	44.08	4.35	54.69	377.1	21.1	0.974	1.80E-08
--	--	1.39E-06	0.833	58.65	5.79	54.58	376.3	21.1	0.974	1.35E-08
--	--	1.39E-06	0.970	68.30	6.74	54.52	375.9	21.1	0.974	1.16E-08
--	--	1.39E-06	0.975	68.65	6.77	54.51	375.9	21.1	0.974	1.15E-08
--	--	1.39E-06	0.994	69.99	6.90	54.50	375.8	21.1	0.974	1.13E-08
--	--	1.39E-06	1.002	70.55	6.96	54.50	375.8	21.1	0.974	1.12E-08
--	--	1.39E-06	0.996	70.13	6.92	54.50	375.8	21.1	0.974	1.13E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.14E-08

NOTES:

Data entry by:	CAL	Date:	09/09/20
Checked by:	DPM	Date:	09/15/20
File name:	3102001__Permeability Method D ASTM D5084_3.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

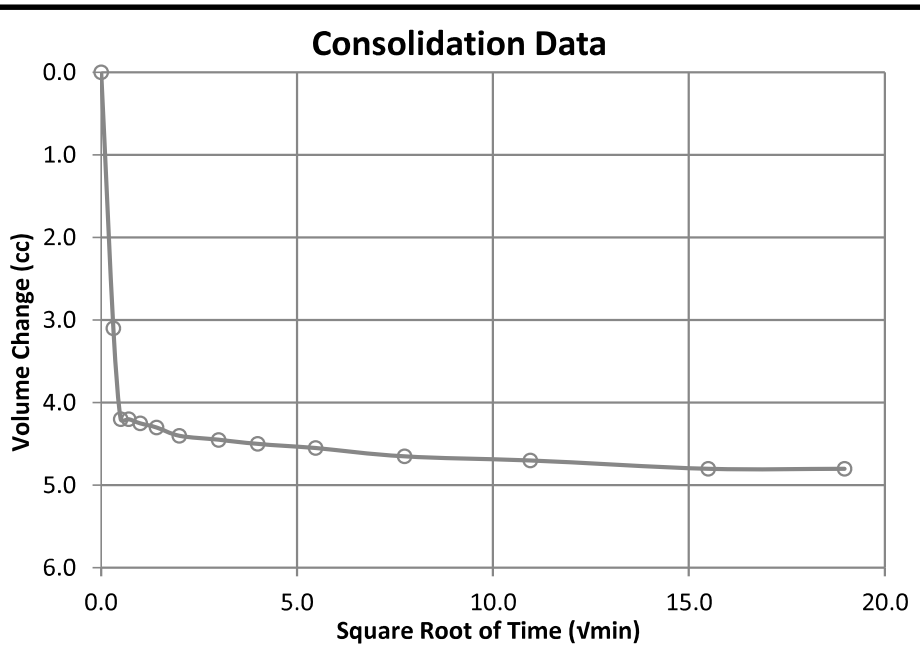
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	91.0	Initial Volume of Sample (cc):	177.3
Final Saturation (%):	100.0	Final Volume of Sample (cc):	175.4
Cell Pressure (psi):	113.0	Volume Change After Consolidation (cc):	18.1
Back Pressure (psi):	58.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	55.0	Final Dial Reading (in):	0.208
Effective Stress (kPa):	379.2	Height Change (in):	0.008
Cell Expansion Correction (cc):	16.19	Initial Area (cm²):	17.45
Cell ID:	24S	Final Area (cm²):	17.30

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.90	0.00
0.1	0.32	4.00	3.10
0.25	0.50	5.10	4.20
0.5	0.71	5.10	4.20
1	1.00	5.15	4.25
2	1.41	5.20	4.30
4	2.00	5.30	4.40
9	3.00	5.35	4.45
16	4.00	5.40	4.50
30	5.48	5.45	4.55
60	7.75	5.55	4.65
120	10.95	5.60	4.70
240	15.49	5.70	4.80
360	18.97	5.70	4.80



Saturation

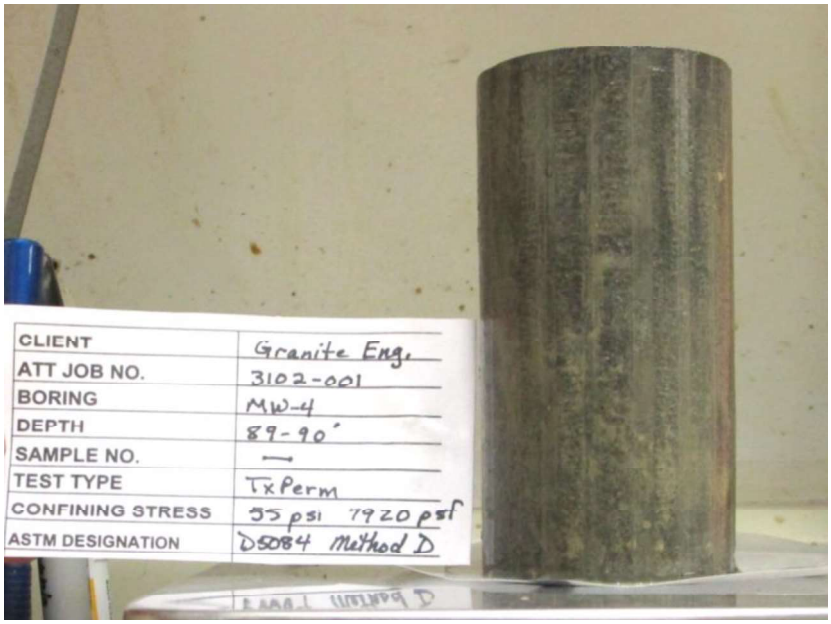
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.6	46.2	12.90	13.90	38.0	1.00	2.0	7.6	0.76
50.0	60.0	48.7	58.0	14.30	15.10	48.0	0.80	2.0	9.3	0.93
60.0	70.0	58.6	68.3	15.30	15.40	58.0	0.10	2.0	9.7	0.97

File name: 3102001__Permeability Method D ASTM D5084_3.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_perm_mw-4_89-90.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-78'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/12/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	228.9	Initial Wet Density (pcf):	150.7
After Test Mass of Wet Soil (g):	230.5	Initial Dry Density (pcf):	143.7
Mass of Dry Soil and Pan (g):	225.0	Initial Wet Density (kg/m³):	2414
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2302
Diameter (in):	1.85	Initial Moisture (%):	4.9
Initial Sample Height (in):	2.15	Final Wet Density (pcf):	154.6
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	146.4
		Final Wet Density (kg/m³):	2476
Back Pressure (psi):	58.0	Final Dry Density (kg/m³):	2345
Cell Pressure (psi):	98.0	Final Moisture (%):	5.6

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	4.230	297.83	54.59	37.89	261.2	21.1	0.974	1.17E-09
5	--	1.12E-06	4.950	348.52	63.88	37.53	258.7	21.1	0.974	9.99E-10
5	--	1.12E-06	5.620	395.70	72.53	37.19	256.4	21.1	0.974	8.80E-10
5	--	1.12E-06	6.340	446.39	81.82	36.83	253.9	21.1	0.974	7.80E-10
5	--	1.12E-06	7.000	492.86	90.34	36.50	251.7	21.1	0.974	7.06E-10
5	--	1.12E-06	7.630	537.22	98.47	36.19	249.5	21.1	0.974	6.48E-10
5	--	1.12E-06	8.200	577.35	105.82	35.90	247.5	21.1	0.974	6.03E-10
5	--	1.12E-06	8.720	613.96	112.53	35.64	245.7	21.1	0.974	5.67E-10
5	--	1.12E-06	9.210	648.47	118.86	35.40	244.0	21.1	0.974	5.37E-10
5	--	1.12E-06	9.630	678.04	124.28	35.19	242.6	21.1	0.974	5.13E-10
5	--	1.12E-06	10.010	704.79	129.18	35.00	241.3	21.1	0.974	4.94E-10

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.28E-10

NOTES:	Reached maximum flow pump transducer pressure prior to meeting permeability termination criteria. The actual permeability value is probably slower.

Data entry by:	CAL	Date:	09/09/20
Checked by:	DPM	Date:	09/17/20
File name:	3102001__Permeability Method D ASTM D5084_4.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

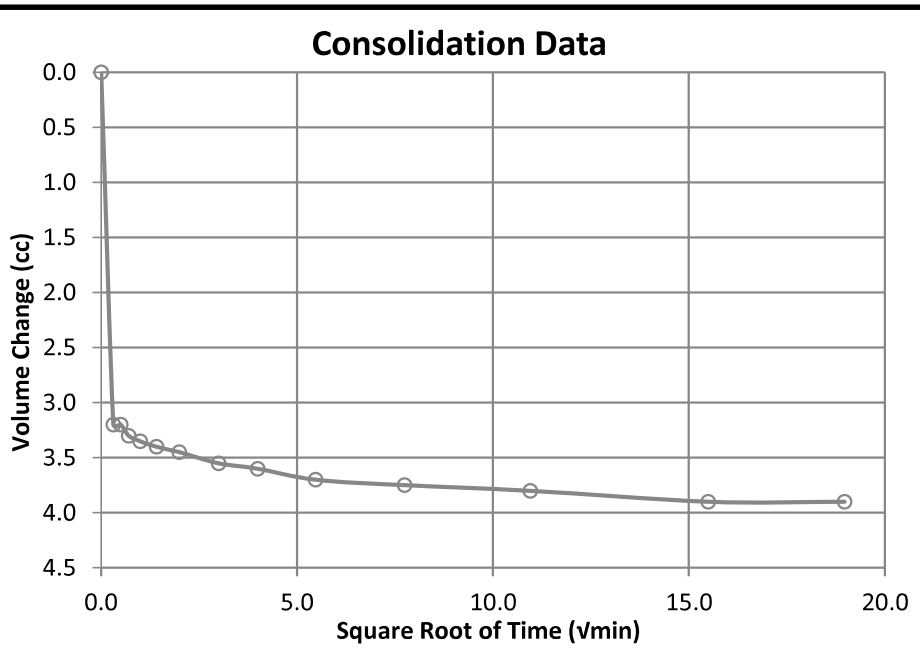
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-78'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/12/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	85.2	Initial Volume of Sample (cc):	94.9
Final Saturation (%):	100.0	Final Volume of Sample (cc):	93.1
Cell Pressure (psi):	98.0	Volume Change After Consolidation (cc):	14.1
Back Pressure (psi):	58.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	40.0	Final Dial Reading (in):	0.203
Effective Stress (kPa):	275.8	Height Change (in):	0.003
Cell Expansion Correction (cc):	12.35	Initial Area (cm²):	17.36
Cell ID:	8S	Final Area (cm²):	17.06

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.00	0.00
0.1	0.32	4.20	3.20
0.25	0.50	4.20	3.20
0.5	0.71	4.30	3.30
1	1.00	4.35	3.35
2	1.41	4.40	3.40
4	2.00	4.45	3.45
9	3.00	4.55	3.55
16	4.00	4.60	3.60
30	5.48	4.70	3.70
60	7.75	4.75	3.75
120	10.95	4.80	3.80
240	15.49	4.90	3.90
360	18.97	4.90	3.90



Saturation

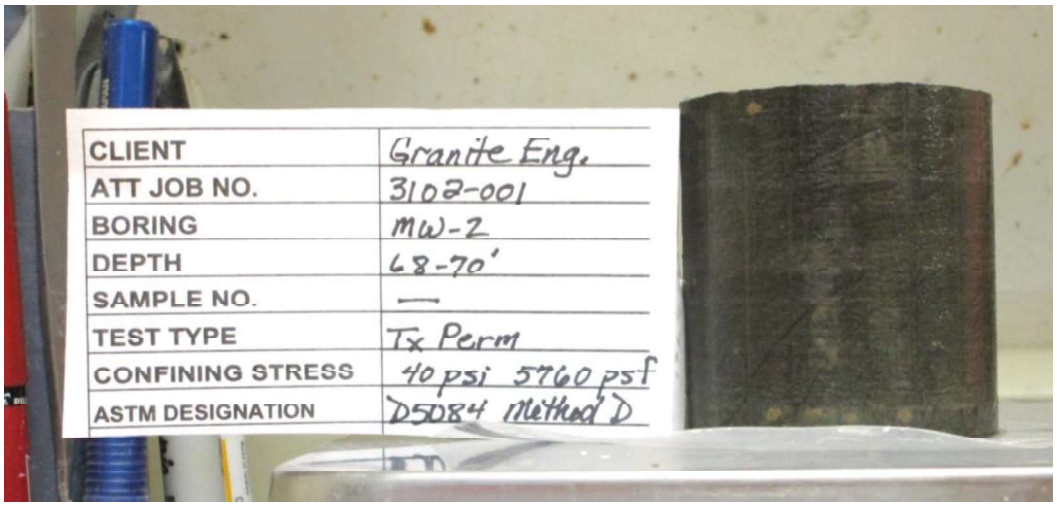
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.0	48.1	9.50	10.50	38.0	1.00	2.0	9.1	0.91
50.0	60.0	49.0	58.4	10.70	11.60	48.0	0.90	2.0	9.4	0.94
60.0	70.0	59.0	68.5	12.10	12.20	58.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_4.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-70'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/12/20
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_perm_mw-2_68-70.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	238.3	Initial Wet Density (pcf):	104.4
After Test Mass of Wet Soil (g):	274.0	Initial Dry Density (pcf):	93.7
Mass of Dry Soil and Pan (g):	397.1	Initial Wet Density (kg/m³):	1673
Mass of Pan (g):	183.2	Initial Dry Density (kg/m³):	1502
Diameter (in):	1.92	Initial Moisture (%):	11.4
Initial Sample Height (in):	3.02	Final Wet Density (pcf):	128.7
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	100.4
		Final Wet Density (kg/m³):	2061
Back Pressure (psi):	78.0	Final Dry Density (kg/m³):	1609
Cell Pressure (psi):	86.0	Final Moisture (%):	28.1

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05
--	--	1.11E-03	0.102	7.18	0.94	7.95	54.8	20.9	0.979	6.59E-05
--	--	1.11E-03	0.100	7.04	0.93	7.95	54.8	20.9	0.979	6.72E-05
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 6.66E-05

NOTES:

Data entry by:	CAL	Date:	09/10/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_5.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

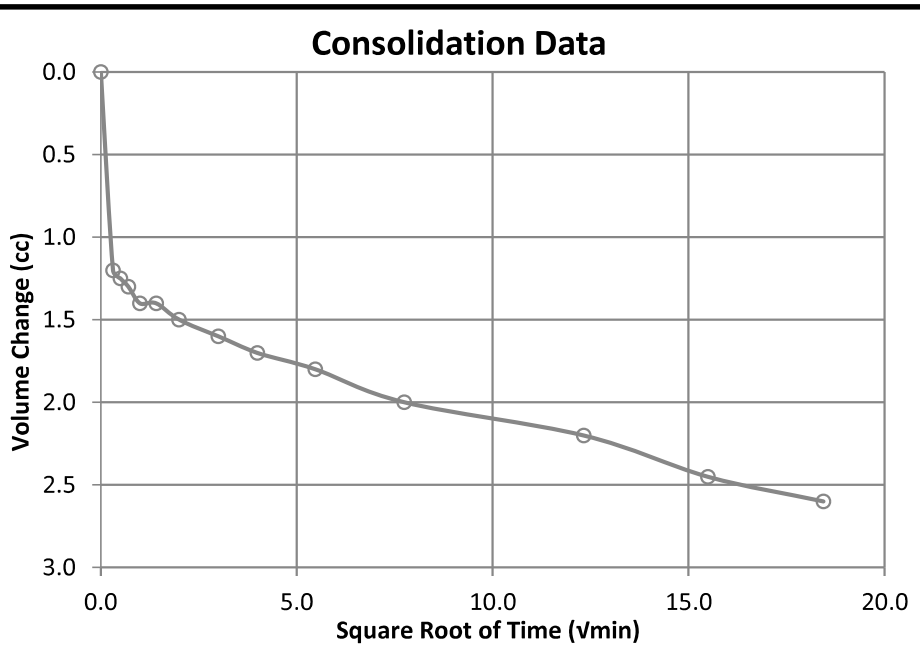
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	39.4	Initial Volume of Sample (cc):	142.5
Final Saturation (%):	100.0	Final Volume of Sample (cc):	132.9
Cell Pressure (psi):	86.0	Volume Change After Consolidation (cc):	23.9
Back Pressure (psi):	78.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	8.0	Final Dial Reading (in):	0.220
Effective Stress (kPa):	55.2	Height Change (in):	0.02
Cell Expansion Correction (cc):	14.39	Initial Area (cm²):	18.60
Cell ID:	4P	Final Area (cm²):	17.48

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.20	0.00
0.1	0.32	2.40	1.20
0.25	0.50	2.45	1.25
0.5	0.71	2.50	1.30
1	1.00	2.60	1.40
2	1.41	2.60	1.40
4	2.00	2.70	1.50
9	3.00	2.80	1.60
16	4.00	2.90	1.70
30	5.48	3.00	1.80
60	7.75	3.20	2.00
152	12.33	3.40	2.20
240	15.49	3.65	2.45
340	18.44	3.80	2.60



Saturation

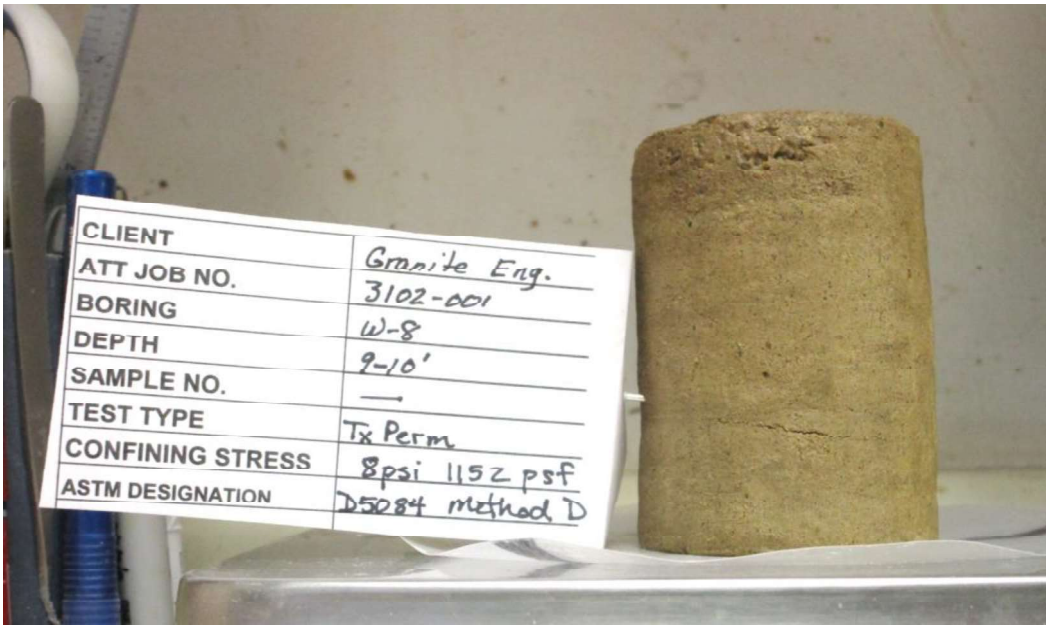
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.9	46.0	17.70	19.00	38.0	1.30	2.0	7.1	0.71
50.0	60.0	49.0	56.5	19.40	20.30	48.0	0.90	2.0	7.5	0.75
60.0	70.0	58.9	67.5	20.60	21.30	58.0	0.70	2.0	8.6	0.86
70.0	80.0	69.1	78.4	21.90	22.50	68.0	0.60	2.0	9.3	0.93
80.0	90.0	79.1	88.6	22.80	22.90	78.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_5.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/5/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_perm_W-8_9-10.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	309.5	Initial Wet Density (pcf):	132.1
After Test Mass of Wet Soil (g):	329.8	Initial Dry Density (pcf):	118.1
Mass of Dry Soil and Pan (g):	400.4	Initial Wet Density (kg/m³):	2116
Mass of Pan (g):	123.6	Initial Dry Density (kg/m³):	1892
Diameter (in):	1.93	Initial Moisture (%):	11.8
Initial Sample Height (in):	3.04	Final Wet Density (pcf):	144.6
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	121.3
		Final Wet Density (kg/m³):	2316
Back Pressure (psi):	88.0	Final Dry Density (kg/m³):	1943
Cell Pressure (psi):	92.0	Final Moisture (%):	19.2

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-05	0.248	17.46	2.27	3.88	26.7	21.1	0.974	3.22E-07
--	--	1.39E-05	0.273	19.22	2.50	3.86	26.6	21.2	0.972	2.92E-07
--	--	1.39E-05	0.285	20.07	2.61	3.86	26.6	21.2	0.972	2.80E-07
--	--	1.39E-05	0.293	20.63	2.68	3.85	26.6	21.3	0.969	2.71E-07
--	--	1.39E-05	0.299	21.05	2.74	3.85	26.5	21.4	0.967	2.65E-07
--	--	1.39E-05	0.300	21.12	2.74	3.85	26.5	21.5	0.965	2.64E-07
--	--	1.39E-05	0.304	21.40	2.78	3.85	26.5	21.6	0.962	2.60E-07
--	--	1.39E-05	0.306	21.55	2.80	3.85	26.5	21.6	0.962	2.58E-07
--	--	1.39E-05	0.307	21.62	2.81	3.85	26.5	21.6	0.962	2.57E-07
--	--	1.39E-05	0.310	21.83	2.84	3.85	26.5	21.7	0.960	2.54E-07

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 2.57E-07

NOTES:

Data entry by:	CAL	Date:	09/11/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_6.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

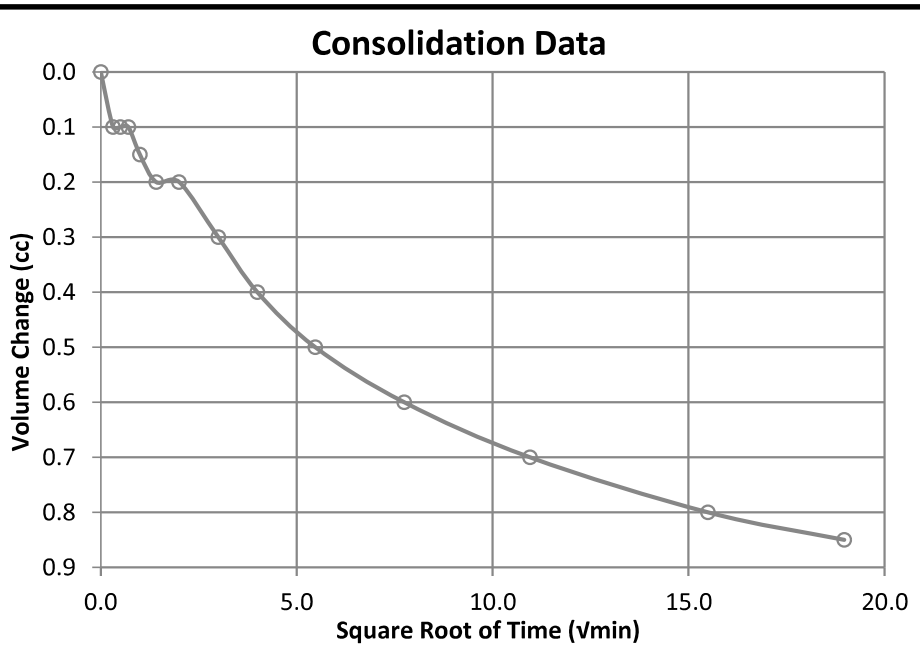
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	78.3	Initial Volume of Sample (cc):	146.2
Final Saturation (%):	100.0	Final Volume of Sample (cc):	142.4
Cell Pressure (psi):	92.0	Volume Change After Consolidation (cc):	17.4
Back Pressure (psi):	88.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	4.0	Final Dial Reading (in):	0.208
Effective Stress (kPa):	27.6	Height Change (in):	0.008
Cell Expansion Correction (cc):	13.57	Initial Area (cm²):	18.95
Cell ID:	12P	Final Area (cm²):	18.51

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	18.10	0.00
0.1	0.32	18.20	0.10
0.25	0.50	18.20	0.10
0.5	0.71	18.20	0.10
1	1.00	18.25	0.15
2	1.41	18.30	0.20
4	2.00	18.30	0.20
9	3.00	18.40	0.30
16	4.00	18.50	0.40
30	5.48	18.60	0.50
60	7.75	18.70	0.60
120	10.95	18.80	0.70
240	15.49	18.90	0.80
360	18.97	18.95	0.85



Saturation

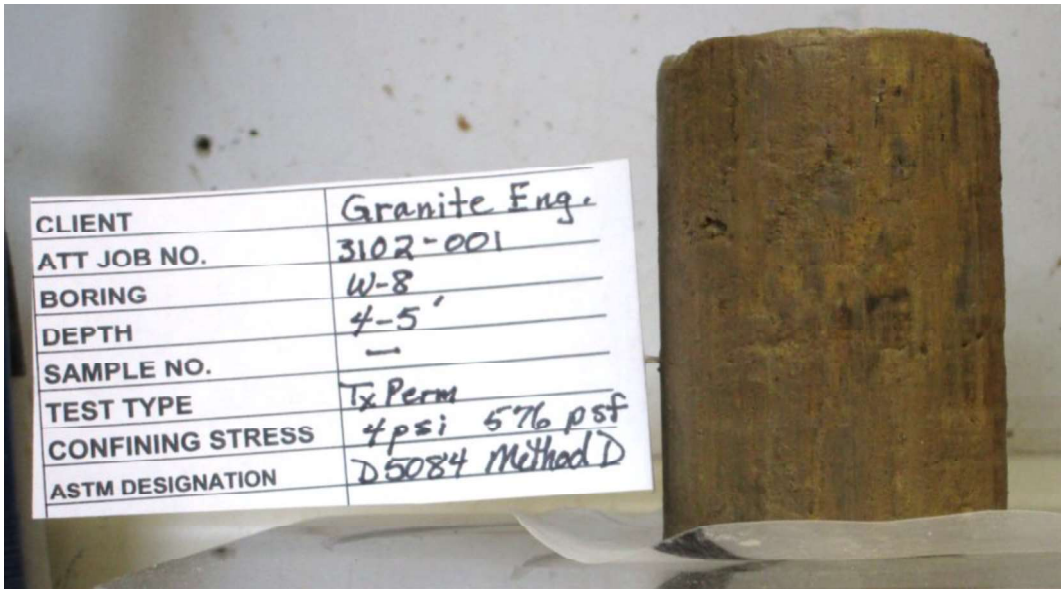
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
50.0	60.0	49.2	58.1	13.00	14.00	38.0	1.00	12.0	8.9	0.89
60.0	70.0	59.1	68.3	4.10	15.00	48.0	10.90	12.0	9.2	0.92
70.0	80.0	69.0	78.4	16.00	16.70	58.0	0.70	12.0	9.4	0.94
80.0	90.0	79.2	88.4	17.10	17.80	68.0	0.70	12.0	9.2	0.92
90.0	100.0	88.9	98.5	17.85	17.90	78.0	0.05	12.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_6.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/5/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_perm_w-8_4-5.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	305.3	Initial Wet Density (pcf):	130.4
After Test Mass of Wet Soil (g):	314.4	Initial Dry Density (pcf):	107.1
Mass of Dry Soil and Pan (g):	388.7	Initial Wet Density (kg/m³):	2089
Mass of Pan (g):	137.9	Initial Dry Density (kg/m³):	1716
Diameter (in):	1.93	Initial Moisture (%):	21.7
Initial Sample Height (in):	3.06	Final Wet Density (pcf):	141.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	113.2
		Final Wet Density (kg/m³):	2274
Back Pressure (psi):	98.0	Final Dry Density (kg/m³):	1814
Cell Pressure (psi):	102.0	Final Moisture (%):	25.3

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	6.94E-06	0.630	44.36	5.71	3.69	25.4	21.2	0.972	6.63E-08
--	--	6.94E-06	0.660	46.47	5.99	3.67	25.3	21.2	0.972	6.33E-08
--	--	6.94E-06	0.690	48.58	6.26	3.66	25.2	21.2	0.972	6.05E-08
--	--	6.94E-06	0.730	51.40	6.62	3.64	25.1	20.9	0.979	5.76E-08
--	--	6.94E-06	0.740	52.10	6.71	3.63	25.0	21.2	0.972	5.64E-08
--	--	6.94E-06	0.772	54.36	7.00	3.61	24.9	21.1	0.974	5.42E-08
--	--	6.94E-06	0.793	55.83	7.19	3.60	24.8	20.9	0.979	5.30E-08
--	--	6.94E-06	0.815	57.38	7.39	3.59	24.8	21.1	0.974	5.14E-08
--	--	6.94E-06	0.820	57.74	7.44	3.59	24.8	20.9	0.979	5.13E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.25E-08

NOTES:

Data entry by:	CAL	Date:	09/15/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_9.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

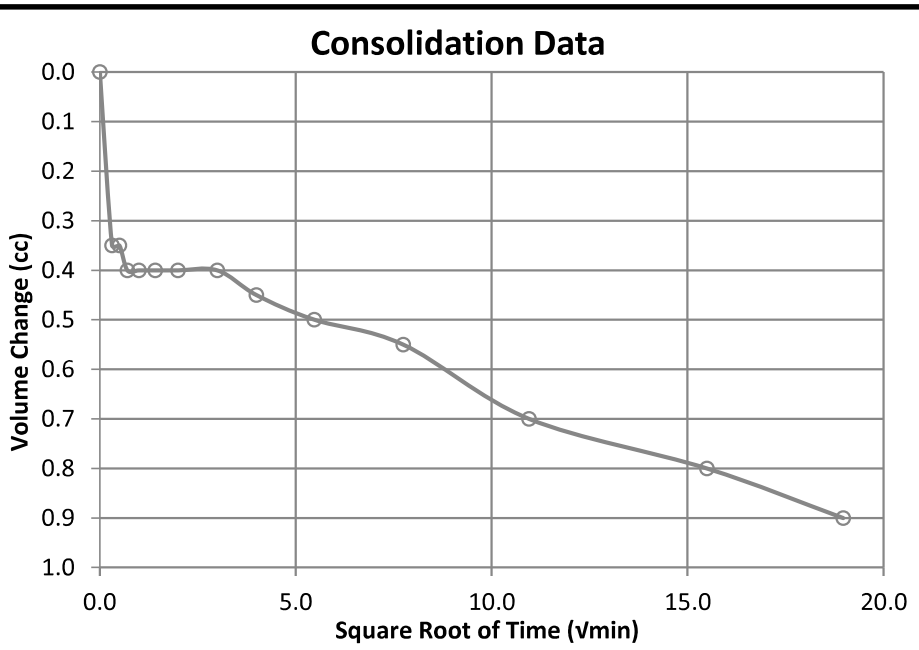
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	146.1
Final Saturation (%):	100.0	Final Volume of Sample (cc):	138.3
Cell Pressure (psi):	102.0	Volume Change After Consolidation (cc):	22.9
Back Pressure (psi):	98.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	4.0	Final Dial Reading (in):	0.202
Effective Stress (kPa):	27.6	Height Change (in):	0.002
Cell Expansion Correction (cc):	15.04	Initial Area (cm²):	18.82
Cell ID:	3P	Final Area (cm²):	17.82

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.30	0.00
0.1	0.32	0.65	0.35
0.25	0.50	0.65	0.35
0.5	0.71	0.70	0.40
1	1.00	0.70	0.40
2	1.41	0.70	0.40
4	2.00	0.70	0.40
9	3.00	0.70	0.40
16	4.00	0.75	0.45
30	5.48	0.80	0.50
60	7.75	0.85	0.55
120	10.95	1.00	0.70
240	15.49	1.10	0.80
360	18.97	1.20	0.90



Saturation

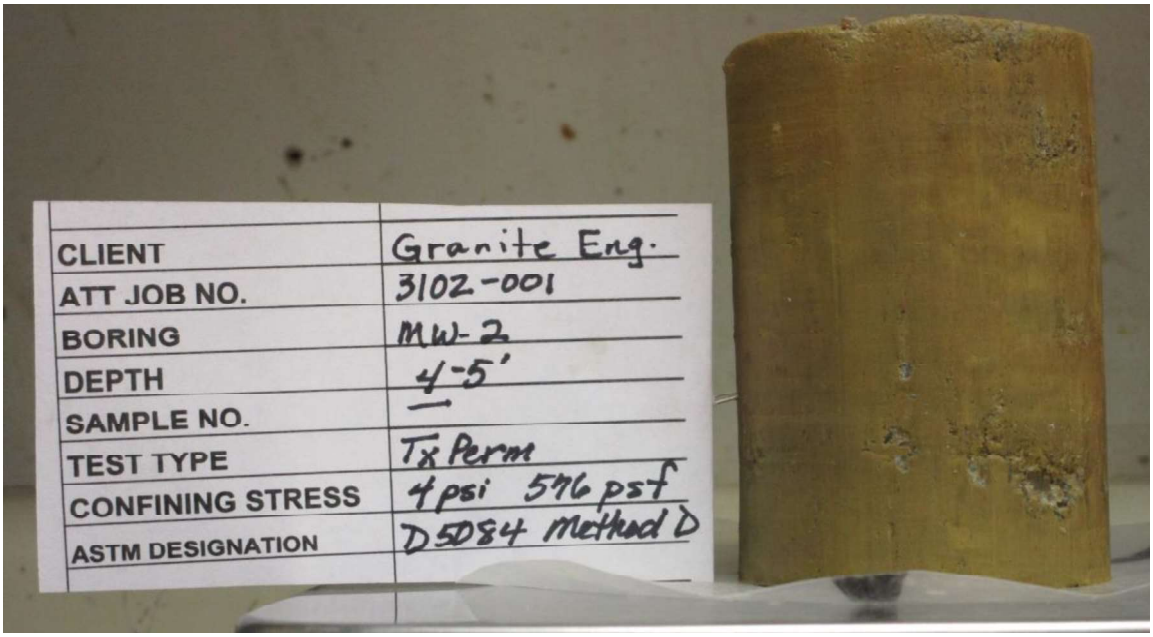
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
60.0	70.0	59.0	67.2	15.70	16.90	58.0	1.20	2.0	8.2	0.82
70.0	80.0	69.3	78.1	17.70	18.90	68.0	1.20	2.0	8.8	0.88
80.0	90.0	79.4	88.5	19.40	20.30	78.0	0.90	2.0	9.1	0.91
90.0	100.0	89.2	98.6	20.60	21.70	88.0	1.10	2.0	9.4	0.94
100.0	110.0	99.1	108.6	22.00	22.20	98.0	0.20	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_9.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/11/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_MW-2_4-5.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/4/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	215.5	Initial Wet Density (pcf):	130.7
After Test Mass of Wet Soil (g):	214.8	Initial Dry Density (pcf):	109.9
Mass of Dry Soil and Pan (g):	298.3	Initial Wet Density (kg/m³):	2093
Mass of Pan (g):	117.0	Initial Dry Density (kg/m³):	1761
Diameter (in):	1.91	Initial Moisture (%):	18.9
Initial Sample Height (in):	2.19	Final Wet Density (pcf):	135.4
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	114.3
		Final Wet Density (kg/m³):	2169
Back Pressure (psi):	88.0	Final Dry Density (kg/m³):	1830
Cell Pressure (psi):	97.0	Final Moisture (%):	18.5

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.530	37.32	6.79	8.74	60.2	21.0	0.976	8.91E-09
5	--	1.12E-06	0.614	43.23	7.87	8.69	59.9	21.1	0.974	7.68E-09
5	--	1.12E-06	0.671	47.24	8.60	8.66	59.7	21.1	0.974	7.02E-09
5	--	1.12E-06	0.786	55.34	10.07	8.61	59.3	20.8	0.981	6.04E-09
5	--	1.12E-06	0.820	57.74	10.51	8.59	59.2	20.9	0.979	5.78E-09
5	--	1.12E-06	0.876	61.68	11.23	8.56	59.0	21.1	0.974	5.38E-09
5	--	1.12E-06	0.923	64.99	11.83	8.54	58.9	21.2	0.972	5.09E-09
5	--	1.12E-06	0.976	68.72	12.51	8.51	58.7	20.9	0.979	4.85E-09
5	--	1.12E-06	0.980	69.00	12.56	8.51	58.7	20.8	0.981	4.84E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.04E-09

NOTES:

Data entry by:	CAL	Date:	09/15/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_10.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

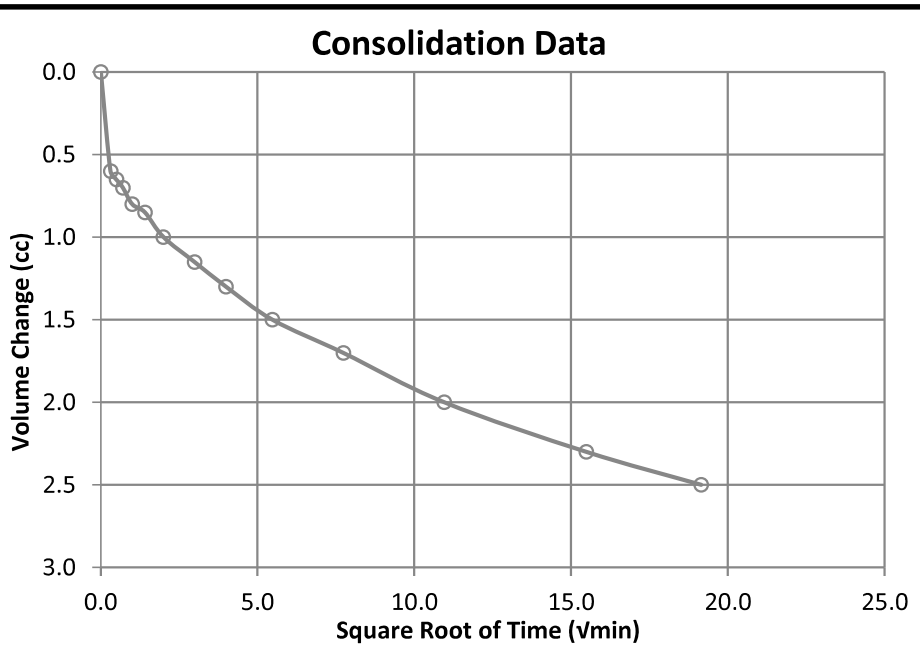
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/4/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	99.1	Initial Volume of Sample (cc):	102.9
Final Saturation (%):	100.0	Final Volume of Sample (cc):	99.0
Cell Pressure (psi):	97.0	Volume Change After Consolidation (cc):	14.9
Back Pressure (psi):	88.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	9.0	Final Dial Reading (in):	0.227
Effective Stress (kPa):	62.1	Height Change (in):	0.027
Cell Expansion Correction (cc):	11.00	Initial Area (cm²):	18.50
Cell ID:	15S	Final Area (cm²):	18.03

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	14.20	0.00
0.1	0.32	14.80	0.60
0.25	0.50	14.85	0.65
0.5	0.71	14.90	0.70
1	1.00	15.00	0.80
2	1.41	15.05	0.85
4	2.00	15.20	1.00
9	3.00	15.35	1.15
16	4.00	15.50	1.30
30	5.48	15.70	1.50
60	7.75	15.90	1.70
120	10.95	16.20	2.00
240	15.49	16.50	2.30
367	19.16	16.70	2.50



Saturation

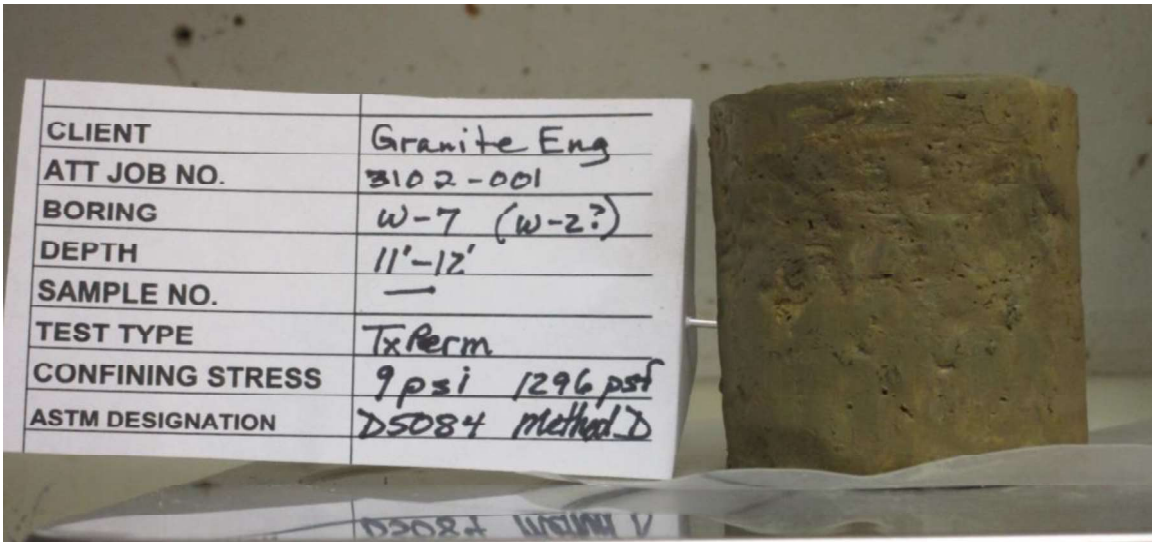
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
50.0	60.0	49.2	58.1	10.50	11.20	48.0	0.70	2.0	8.9	0.89
60.0	70.0	59.1	68.1	11.20	11.90	58.0	0.70	2.0	9.0	0.90
70.0	80.0	69.1	78.3	12.20	13.00	68.0	0.80	2.0	9.2	0.92
80.0	90.0	79.0	88.3	13.20	14.00	78.0	0.80	2.0	9.3	0.93
90.0	100.0	89.0	98.5	14.20	14.20	88.0	0.00	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_10.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/4/200
LOCATION	--	DESCRIPTION	soil



NOTES	Bag appeared to be labled W-2

File name: 3102001_PERM_W-7_11-12.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	312.4	Initial Wet Density (pcf):	139.8
After Test Mass of Wet Soil (g):	320.6	Initial Dry Density (pcf):	126.1
Mass of Dry Soil and Pan (g):	421.1	Initial Wet Density (kg/m³):	2239
Mass of Pan (g):	139.3	Initial Dry Density (kg/m³):	2020
Diameter (in):	1.94	Initial Moisture (%):	10.8
Initial Sample Height (in):	2.90	Final Wet Density (pcf):	139.5
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	122.6
		Final Wet Density (kg/m³):	2234
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	1965
Cell Pressure (psi):	117.0	Final Moisture (%):	13.7

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
15	--	3.21E-06	0.695	48.93	6.70	8.65	59.7	21.5	0.965	2.35E-08
15	--	3.21E-06	0.881	62.03	8.50	8.56	59.0	21.4	0.967	1.86E-08
5	--	1.12E-06	0.771	54.29	7.44	8.61	59.4	21.4	0.967	7.40E-09
5	--	1.12E-06	0.826	58.16	7.97	8.59	59.2	21.5	0.965	6.89E-09
5	--	1.12E-06	0.896	63.09	8.64	8.55	59.0	21.7	0.960	6.32E-09
5	--	1.12E-06	0.963	67.80	9.29	8.52	58.7	21.7	0.960	5.88E-09
5	--	1.12E-06	1.006	70.83	9.70	8.50	58.6	21.7	0.960	5.63E-09
5	--	1.12E-06	0.975	68.65	9.40	8.51	58.7	21.2	0.972	5.88E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.93E-09

NOTES:

Data entry by:	CAL	Date:	09/16/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_11.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

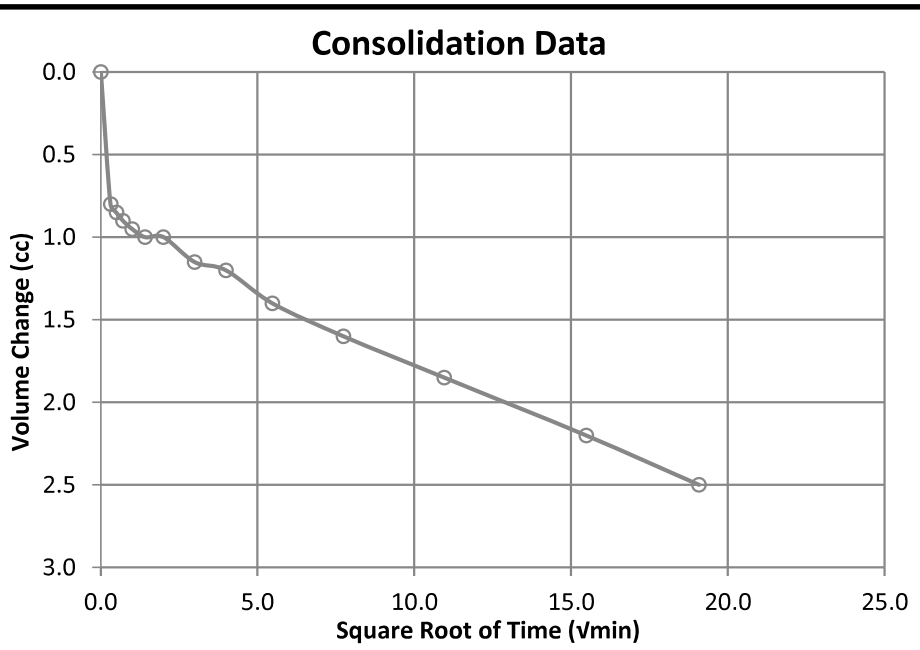
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	92.2	Initial Volume of Sample (cc):	139.5
Final Saturation (%):	100.0	Final Volume of Sample (cc):	143.5
Cell Pressure (psi):	117.0	Volume Change After Consolidation (cc):	20.3
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.400
Effective Stress (psi):	9.0	Final Dial Reading (in):	0.421
Effective Stress (kPa):	62.1	Height Change (in):	0.021
Cell Expansion Correction (cc):	24.26	Initial Area (cm²):	18.97
Cell ID:	2P	Final Area (cm²):	19.65

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	18.50	0.00
0.1	0.32	19.30	0.80
0.25	0.50	19.35	0.85
0.5	0.71	19.40	0.90
1	1.00	19.45	0.95
2	1.41	19.50	1.00
4	2.00	19.50	1.00
9	3.00	19.65	1.15
16	4.00	19.70	1.20
30	5.48	19.90	1.40
60	7.75	20.10	1.60
120	10.95	20.35	1.85
240	15.49	20.70	2.20
364	19.08	21.00	2.50



Saturation

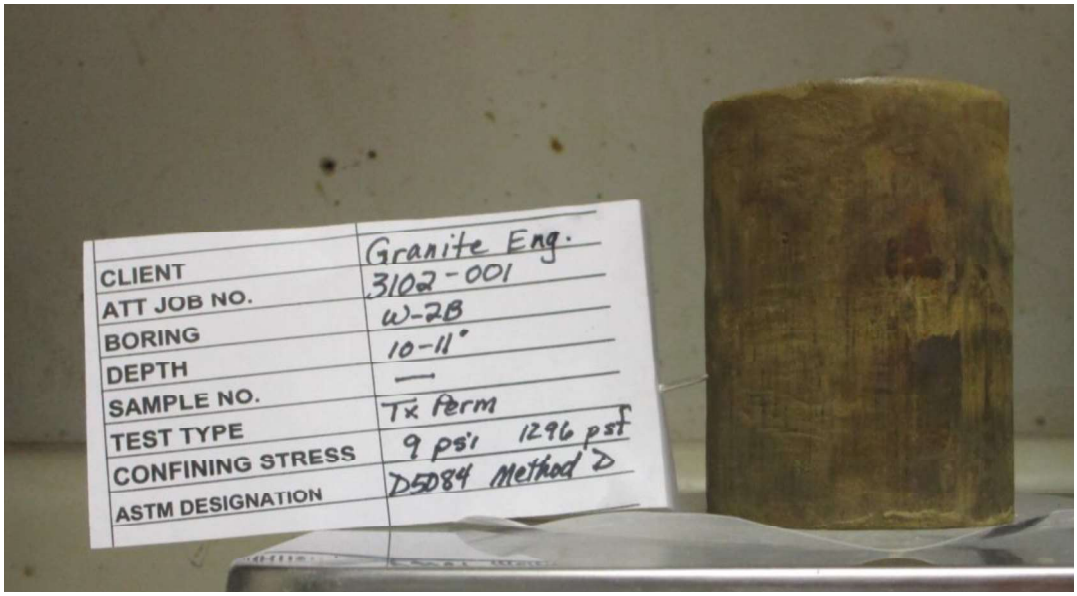
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	68.6	77.3	12.70	13.80	68.0	1.10	2.0	8.7	0.87
80.0	90.0	79.0	87.7	14.50	15.50	78.0	1.00	2.0	8.7	0.87
90.0	100.0	89.0	97.6	15.80	16.90	88.0	1.10	2.0	8.6	0.86
100.0	110.0	99.0	108.2	16.95	18.10	98.0	1.15	2.0	9.2	0.92
110.0	120.0	108.8	118.6	18.40	18.50	108.0	0.10	2.0	9.8	0.98

File name: 3102001__Permeability Method D ASTM D5084_11.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/30/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_W-2B_10-11.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	311.7	Initial Wet Density (pcf):	135.4
After Test Mass of Wet Soil (g):	316.4	Initial Dry Density (pcf):	117.4
Mass of Dry Soil and Pan (g):	390.1	Initial Wet Density (kg/m³):	2168
Mass of Pan (g):	119.7	Initial Dry Density (kg/m³):	1881
Diameter (in):	1.94	Initial Moisture (%):	15.3
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	135.4
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	115.7
		Final Wet Density (kg/m³):	2168
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	1853
Cell Pressure (psi):	125.0	Final Moisture (%):	17.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.556	39.15	5.20	16.72	115.3	21.1	0.974	1.08E-08
5	--	1.12E-06	0.562	39.57	5.25	16.72	115.3	20.8	0.981	1.08E-08
5	--	1.12E-06	0.574	40.41	5.36	16.71	115.2	20.8	0.981	1.06E-08
5	--	1.12E-06	0.594	41.82	5.55	16.70	115.2	20.7	0.983	1.02E-08
5	--	1.12E-06	0.599	42.17	5.60	16.70	115.1	20.7	0.983	1.01E-08
5	--	1.12E-06	0.584	41.12	5.46	16.71	115.2	20.6	0.986	1.04E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.03E-08

NOTES:

Data entry by:	CAL	Date:	09/16/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_12.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

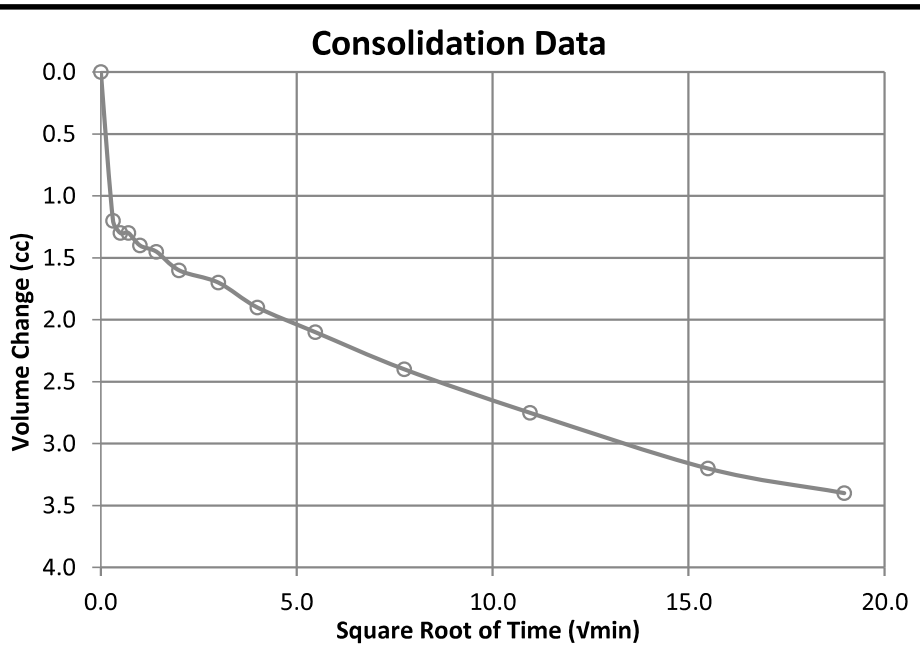
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	99.0	Initial Volume of Sample (cc):	143.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	145.9
Cell Pressure (psi):	128.0	Volume Change After Consolidation (cc):	23.1
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	20.0	Final Dial Reading (in):	0.217
Effective Stress (kPa):	137.9	Height Change (in):	0.017
Cell Expansion Correction (cc):	25.28	Initial Area (cm²):	18.97
Cell ID:	8P	Final Area (cm²):	19.37

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.40	0.00
0.1	0.32	1.60	1.20
0.25	0.50	1.70	1.30
0.5	0.71	1.70	1.30
1	1.00	1.80	1.40
2	1.41	1.85	1.45
4	2.00	2.00	1.60
9	3.00	2.10	1.70
16	4.00	2.30	1.90
30	5.48	2.50	2.10
60	7.75	2.80	2.40
120	10.95	3.15	2.75
240	15.49	3.60	3.20
360	18.97	3.80	3.40



Saturation

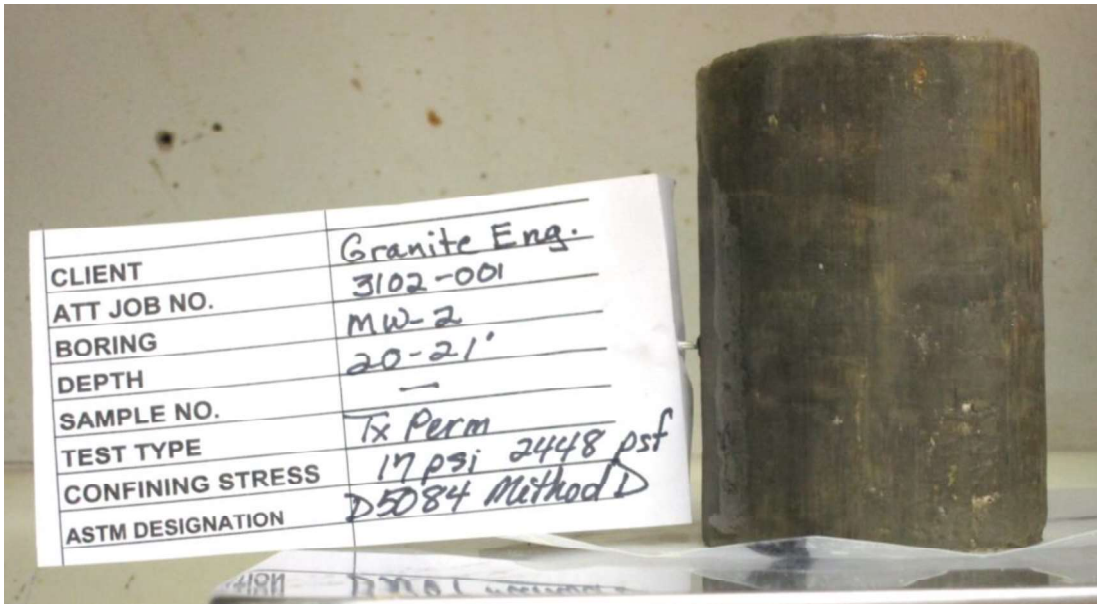
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	68.6	76.9	15.40	16.20	68.0	0.80	2.0	8.3	0.83
80.0	90.0	78.6	87.8	16.40	17.30	78.0	0.90	2.0	9.2	0.92
90.0	100.0	88.5	97.8	17.50	18.20	88.0	0.70	2.0	9.3	0.93
100.0	110.0	98.5	107.7	18.50	19.20	98.0	0.70	2.0	9.2	0.92
110.0	120.0	108.6	118.2	20.80	20.90	108.0	0.10	2.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_12.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/11/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_MW-2_20-21.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/6/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	261.8	Initial Wet Density (pcf):	150.0
After Test Mass of Wet Soil (g):	264.2	Initial Dry Density (pcf):	142.6
Mass of Dry Soil and Pan (g):	388.6	Initial Wet Density (kg/m³):	2402
Mass of Pan (g):	139.6	Initial Dry Density (kg/m³):	2285
Diameter (in):	1.84	Initial Moisture (%):	5.1
Initial Sample Height (in):	2.51	Final Wet Density (pcf):	147.1
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	138.6
		Final Wet Density (kg/m³):	2356
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	2220
Cell Pressure (psi):	146.0	Final Moisture (%):	6.1

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.709	49.92	7.81	37.65	259.6	21.6	0.962	7.84E-09
5	--	1.12E-06	1.324	93.22	14.59	37.34	257.4	21.6	0.962	4.20E-09
5	--	1.12E-06	1.982	139.55	21.85	37.01	255.2	21.6	0.962	2.80E-09
5	--	1.12E-06	2.590	182.36	28.55	36.71	253.1	21.6	0.962	2.15E-09
5	--	1.12E-06	3.070	216.16	33.84	36.47	251.4	21.6	0.962	1.81E-09
5	--	1.12E-06	3.360	236.57	37.03	36.32	250.4	21.7	0.960	1.65E-09
5	--	1.12E-06	3.560	250.66	39.24	36.22	249.7	21.8	0.958	1.55E-09
5	--	1.12E-06	3.650	256.99	40.23	36.18	249.4	21.8	0.958	1.52E-09
5	--	1.12E-06	3.800	267.55	41.88	36.10	248.9	21.2	0.972	1.48E-09
5	--	1.12E-06	3.480	245.02	38.36	36.26	250.0	21.1	0.974	1.62E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.54E-09

NOTES:

Data entry by:	CAL	Date:	09/17/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_13.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

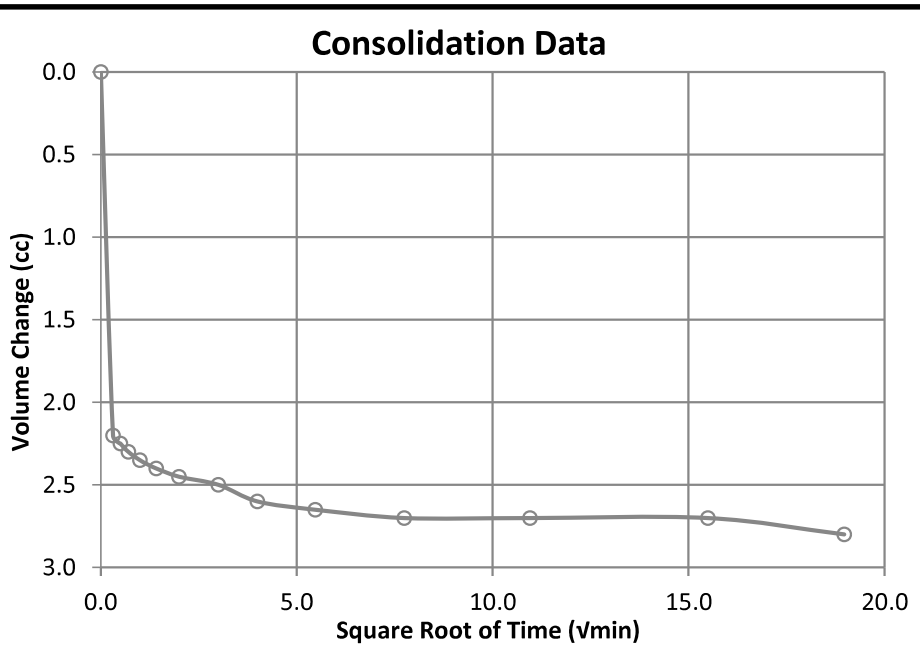
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/6/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	85.1	Initial Volume of Sample (cc):	109.0
Final Saturation (%):	83.6	Final Volume of Sample (cc):	112.2
Cell Pressure (psi):	146.0	Volume Change After Consolidation (cc):	14.2
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.300
Effective Stress (psi):	38.0	Final Dial Reading (in):	0.297
Effective Stress (kPa):	262.0	Height Change (in):	-0.003
Cell Expansion Correction (cc):	17.38	Initial Area (cm²):	17.08
Cell ID:	14S	Final Area (cm²):	17.56

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	5.50	0.00
0.1	0.32	7.70	2.20
0.25	0.50	7.75	2.25
0.5	0.71	7.80	2.30
1	1.00	7.85	2.35
2	1.41	7.90	2.40
4	2.00	7.95	2.45
9	3.00	8.00	2.50
16	4.00	8.10	2.60
30	5.48	8.15	2.65
60	7.75	8.20	2.70
120	10.95	8.20	2.70
240	15.49	8.20	2.70
360	18.97	8.30	2.80



Saturation

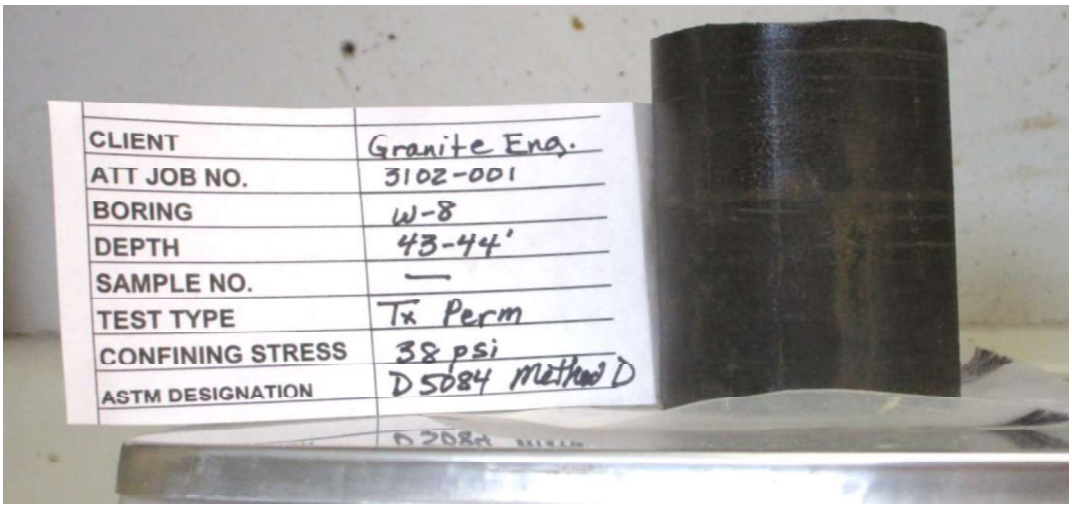
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	69.1	78.2	10.20	10.80	68.0	0.60	2.0	9.1	0.91
80.0	90.0	78.9	88.0	10.90	11.50	78.0	0.60	2.0	9.1	0.91
90.0	100.0	88.4	97.7	11.50	12.00	88.0	0.50	2.0	9.3	0.93
100.0	110.0	98.7	108.1	12.00	12.60	98.0	0.60	2.0	9.4	0.94
110.0	120.0	108.6	118.1	12.60	12.70	108.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_13.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/6/20
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_PERM_W-8_43-44.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	64-65'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	--
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	355.0	Initial Wet Density (pcf):	155.9
After Test Mass of Wet Soil (g):	357.3	Initial Dry Density (pcf):	148.4
Mass of Dry Soil and Pan (g):	521.3	Initial Wet Density (kg/m³):	2497
Mass of Pan (g):	183.3	Initial Dry Density (kg/m³):	2378
Diameter (in):	1.85	Initial Moisture (%):	5.0
Initial Sample Height (in):	3.25	Final Wet Density (pcf):	157.8
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	149.3
		Final Wet Density (kg/m³):	2528
Back Pressure (psi):	128.0	Final Dry Density (kg/m³):	2391
Cell Pressure (psi):	167.0	Final Moisture (%):	5.7

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	0.040	2.82	0.34	38.98	268.8	21.8	0.958	2.26E-07
--	--	1.39E-06	0.150	10.56	1.28	38.93	268.4	21.8	0.958	6.02E-08
--	--	1.39E-06	0.375	26.40	3.21	38.81	267.6	21.9	0.956	2.40E-08
--	--	1.39E-06	0.473	33.30	4.05	38.76	267.3	21.9	0.956	1.90E-08
--	--	1.39E-06	0.631	44.43	5.41	38.68	266.7	21.9	0.956	1.43E-08
--	--	1.39E-06	0.628	44.22	5.38	38.69	266.7	21.9	0.956	1.43E-08
--	--	1.39E-06	0.740	52.10	6.34	38.63	266.3	21.8	0.958	1.22E-08
--	--	1.39E-06	0.659	46.40	5.65	38.67	266.6	21.8	0.958	1.37E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.36E-08

NOTES:	Unable to achieve skempton's B parameter greater than .84 using normal operating back pressure capability.

Data entry by:	CAL	Date:	09/18/20
Checked by:	KR	Date:	09/23/20
File name:	3102001__Permeability Method D ASTM D5084_14.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

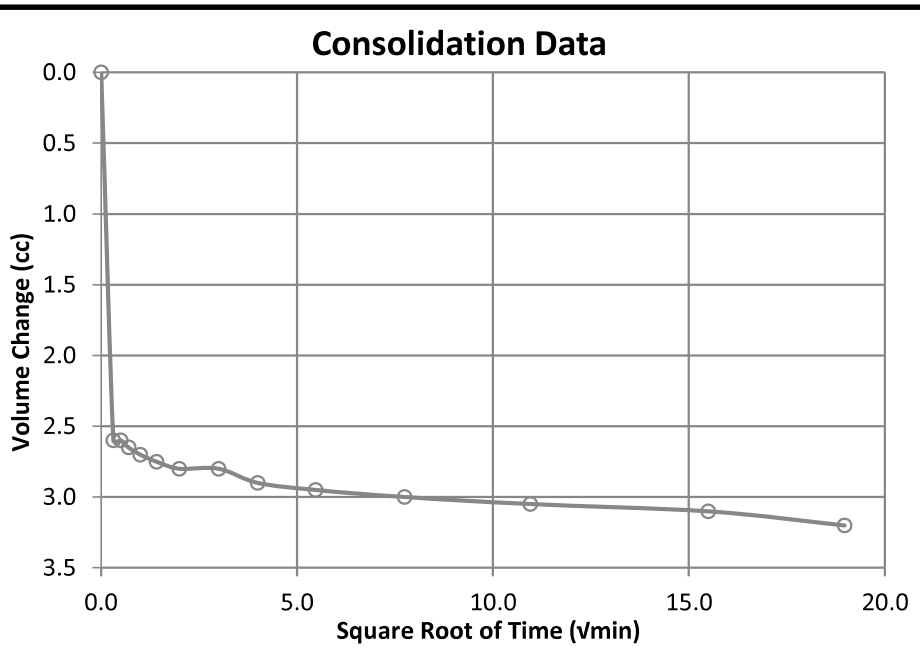
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	64-65'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	--
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	142.2
Final Saturation (%):	100.0	Final Volume of Sample (cc):	141.3
Cell Pressure (psi):	167.0	Volume Change After Consolidation (cc):	18
Back Pressure (psi):	138.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	29.0	Final Dial Reading (in):	0.209
Effective Stress (kPa):	199.9	Height Change (in):	0.009
Cell Expansion Correction (cc):	17.17	Initial Area (cm²):	17.25
Cell ID:	13S	Final Area (cm²):	17.20

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.30	0.00
0.1	0.32	3.90	2.60
0.25	0.50	3.90	2.60
0.5	0.71	3.95	2.65
1	1.00	4.00	2.70
2	1.41	4.05	2.75
4	2.00	4.10	2.80
9	3.00	4.10	2.80
16	4.00	4.20	2.90
30	5.48	4.25	2.95
60	7.75	4.30	3.00
120	10.95	4.35	3.05
240	15.49	4.40	3.10
360	18.97	4.50	3.20



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
90.0	100.0	88.9	96.6	14.10	14.70	88.0	0.60	2.0	7.7	0.77
100.0	110.0	98.7	106.6	14.80	15.50	98.0	0.70	2.0	7.9	0.79
110.0	120.0	108.6	116.8	15.60	16.20	108.0	0.60	2.0	8.2	0.82
120.0	130.0	118.4	126.6	16.40	17.00	118.0	0.60	2.0	8.2	0.82
130.0	140.0	128.3	136.7	17.20	17.20	128.0	0.00	2.0	8.4	0.84

File name: 3102001__Permeability Method D ASTM D5084_14.xlsm

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	37-39'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/13/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	294.3	Initial Wet Density (pcf):	127.3
After Test Mass of Wet Soil (g):	294.9	Initial Dry Density (pcf):	102.9
Mass of Dry Soil and Pan (g):	357.5	Initial Wet Density (kg/m³):	2039
Mass of Pan (g):	119.7	Initial Dry Density (kg/m³):	1648
Diameter (in):	1.94	Initial Moisture (%):	23.8
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	130.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	105.6
		Final Wet Density (kg/m³):	2097
Back Pressure (psi):	128.0	Final Dry Density (kg/m³):	1691
Cell Pressure (psi):	161.0	Final Moisture (%):	24.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	1.499	105.54	14.21	32.25	222.4	21.5	0.965	4.98E-09
--	--	1.39E-06	1.583	111.46	15.00	32.21	222.1	21.8	0.958	4.69E-09
--	--	1.39E-06	1.784	125.61	16.91	32.11	221.4	21.6	0.962	4.18E-09
--	--	1.39E-06	1.790	126.03	16.96	32.11	221.4	21.4	0.967	4.18E-09
--	--	1.39E-06	1.814	127.72	17.19	32.09	221.3	21.4	0.967	4.13E-09
--	--	1.39E-06	1.909	134.41	18.09	32.05	220.9	21.4	0.967	3.92E-09
--	--	1.39E-06	2.001	140.89	18.96	32.00	220.6	21.2	0.972	3.76E-09
--	--	1.39E-06	2.048	144.20	19.41	31.98	220.5	21.2	0.972	3.67E-09
--	--	1.39E-06	2.053	144.55	19.46	31.97	220.4	21.3	0.969	3.66E-09
--	--	1.39E-06	2.063	145.25	19.55	31.97	220.4	21.2	0.972	3.65E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 3.68E-09

NOTES:	Unable to achieve Skempton's B parameter greater than .88 using normal operating back pressure.

Data entry by:	CAL	Date:	09/23/20
Checked by:	KR	Date:	09/23/20
File name:	3102001__Permeability Method D ASTM D5084_15.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

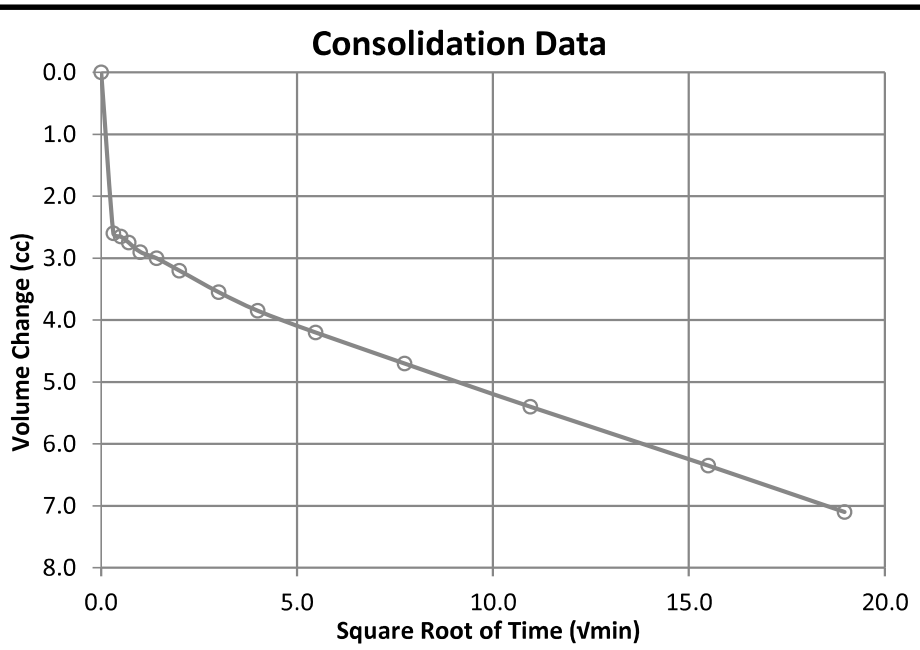
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	37-39'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/13/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	144.3
Final Saturation (%):	100.0	Final Volume of Sample (cc):	140.6
Cell Pressure (psi):	161.0	Volume Change After Consolidation (cc):	29
Back Pressure (psi):	128.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	33.0	Final Dial Reading (in):	0.257
Effective Stress (kPa):	227.5	Height Change (in):	0.057
Cell Expansion Correction (cc):	25.33	Initial Area (cm²):	19.05
Cell ID:	9P	Final Area (cm²):	18.93

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	9.20	0.00
0.1	0.32	11.80	2.60
0.25	0.50	11.85	2.65
0.5	0.71	11.95	2.75
1	1.00	12.10	2.90
2	1.41	12.20	3.00
4	2.00	12.40	3.20
9	3.00	12.75	3.55
16	4.00	13.05	3.85
30	5.48	13.40	4.20
60	7.75	13.90	4.70
120	10.95	14.60	5.40
240	15.49	15.55	6.35
360	18.97	16.30	7.10



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
90.0	100.0	89.0	96.9	18.00	18.80	88.0	0.80	2.0	7.9	0.79
100.0	110.0	99.0	106.9	18.90	19.70	98.0	0.80	2.0	7.9	0.79
110.0	120.0	108.9	117.2	19.80	20.50	108.0	0.70	2.0	8.3	0.83
120.0	130.0	119.0	127.2	20.70	21.40	118.0	0.70	2.0	8.2	0.82
130.0	140.0	129.1	137.9	21.70	21.70	128.0	0.00	2.0	8.8	0.88

File name: 3102001__Permeability Method D ASTM D5084_15.xlsm